

Nature's Gifts to Medicine

By LONNELLE AIKMAN

Paintings by
LLOYD K. TOWNSEND
and DON CROWLEY

Good for what ails you:

Impending dose of castor oil clouds a youngster's face. The familiar purgative comes from the crushed seeds of a medicinal plant used since the time of the ancient Egyptians. In every culture and every age, man has looked to the plant world to cure his ills. Modern pharmacologists still turn to flowers and herbs. From folk remedies to wonder drugs to enslaving narcotics—nature's medicine bag holds them all.

NATIONAL GEOGRAPHIC ARTIST LLOYD K. TOWNSEND

"USE AN OLD INDIAN REMEDY for poison ivy," said a friend. "You boil sycamore bark in water and sop it on. It works like magic."

"My wife has a 90-year-old pal who claims he keeps arthritis away with a daily cup of alfalfa tea," a NATIONAL GEOGRAPHIC editor remarked at a luncheon chat.

"We have an aloe plant in our kitchen," a photographer told me. "It exudes a living lotion, and if I burn my hand, I pull off a leaf or two, squeeze out a kind of jelly, and it stops the pain."

Such plant remedies, or "simples" as they used to be called, seem out of this world of modern pills and potions, with their tongue-tripping chemical names. They recall days when our grandparents and great-grandparents dosed themselves with teas and tonics from the garden, and bought patent medicines guaranteed, like Hamlin's Wizard Oil, "to heal all sores, subdue all pain."



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FEAST fit for a kingfisher: Father pokes his head into the tunnel nest (**above**), bringing a fish to chicks snuggled close to their mother. With noisy cries and open mouths (**left**), the young birds signal their hunger. One chick contends with a fish too large to digest all at once. Only five days old, it struggled for an hour to finish the meal.

To focus on daily nest life, the photographers carefully cut out an opening in a wall of

the burrow to accommodate a camera and flash attachment.

Kingfishers usually raise two broods a year. At each nesting the female lays six or seven glossy white eggs that hatch about 20 days later. The adults share the chore of feeding the young for three to four weeks. When the mature chicks wing away, they roam the countryside alone, like animated jewels. The following spring they seek out mates and start broods of their own. □

Yet a surprising number of present-day drugs (one analysis of prescription ingredients puts it at nearly 50 percent) still come from natural products. From *Aloe vera* commercial firms make sunburn lotion. And in this same herb—which the Bible says was brought to prepare the body of Christ—radiologists have found a substance to ease external atomic-radiation burns.

Moreover, side by side with the universal use of laboratory-created synthetics, we see a growing scientific interest in returning to nature's healing handouts.

"In the next five years I look for a big increase in natural-product medicines," said Dr. Norman R. Farnsworth, professor of pharmacognosy at the University of Illinois. Pharmacognosy is that branch of pharmaceutical science dealing specifically with the chemistry and geography of plants and other raw materials that go into drugs.

"The time is ripe," he added, "partly because of public interest in natural foods and environment. But new sources of crude drugs and better extraction methods also are factors. Our vegetable and animal kingdoms have hardly been touched, and marine biologists and drug companies are just beginning to look for compounds in undersea plant, animal, and microbial organisms."

In 1961 Dr. Farnsworth himself led in clarifying the then little-understood botanical and pharmaceutical nature of the Madagascar periwinkle, which has since yielded priceless agents against some forms of cancer.

He believes that in the United States, no less than in remote jungles, grow many other medically useful plants. He and his students often drive out on mini-expeditions around Chicago, gathering wild plants to cultivate on the university's 40-acre farm.

They make up "voucher specimens" of dried and pressed plants—the all-important proof of a species' correct botanical identity—and carry out intricate chemical and biological procedures in the laboratory to extract and test the active medicinal elements.

To some talented student now starting out in that class, or in one of some seventy other American colleges of pharmacy, may come the thrill of taking part in discovering and developing a new miracle drug.

The drug might even rate a place beside history's great cures and comforts for ailing humanity: pain-killing morphine, for instance, from the double-edged gift of opium

poppies; quinine, tamer of malaria, from cinchona bark; or oil pressed from seeds of the chaulmoogra tree, which was long the only drug considered effective for arresting the frightful progress of leprosy.

WHERE DOES the U.S. drug industry get all the raw plant materials that go into the capsules, liquids, and ointments rolling off assembly lines of pharmaceutical manufacturers?

I caught a whiff of the answer to this question on a visit to the Lyndhurst, New Jersey, warehouses of one of the world's largest dealers in botanicals, S. B. Penick and Company.

A medley of tantalizing smells met us at the door of one building piled high with bumpy bales, bags, and bundles.

"What's that... and that... and that?" I asked my guide, Edson F. Woodward, as my nose picked up a spicy, sweet, or musky odor.

To Ed Woodward, then head of the company's Basic Botanical Division, the assembled bits and pieces of vegetation were as familiar as roses and marigolds in your garden.

Pulling out a few leaves, roots, or bark chips, he called names, origins, and uses: digitalis, or foxglove, leaves produced on a Pennsylvania farm to treat failing hearts; ipecac roots from Brazil to relieve amoebic dysentery and to induce vomiting in cases of accidental poisoning; gum myrrh imported from Ethiopia

(Continued on page 426)

WARNING

Although plants have been utilized in medicines for millenniums, many are poisonous in whole or in part. "The layman who doses himself is gambling with his life," says Dr. Norman R. Farnsworth, a leading authority on the use of natural products as drugs. "Only specialists can tell the difference between potentially useful and harmful substances."

Children particularly should be warned against eating the enticing berries of such common plants as lily of the valley and mistletoe, or sucking nectar or eating fragrant blossoms like those of yellow jasmine, oleander, or autumn crocus. The same beans that yield castor oil (opposite) can kill if as few as two are swallowed.

Potions and poisons

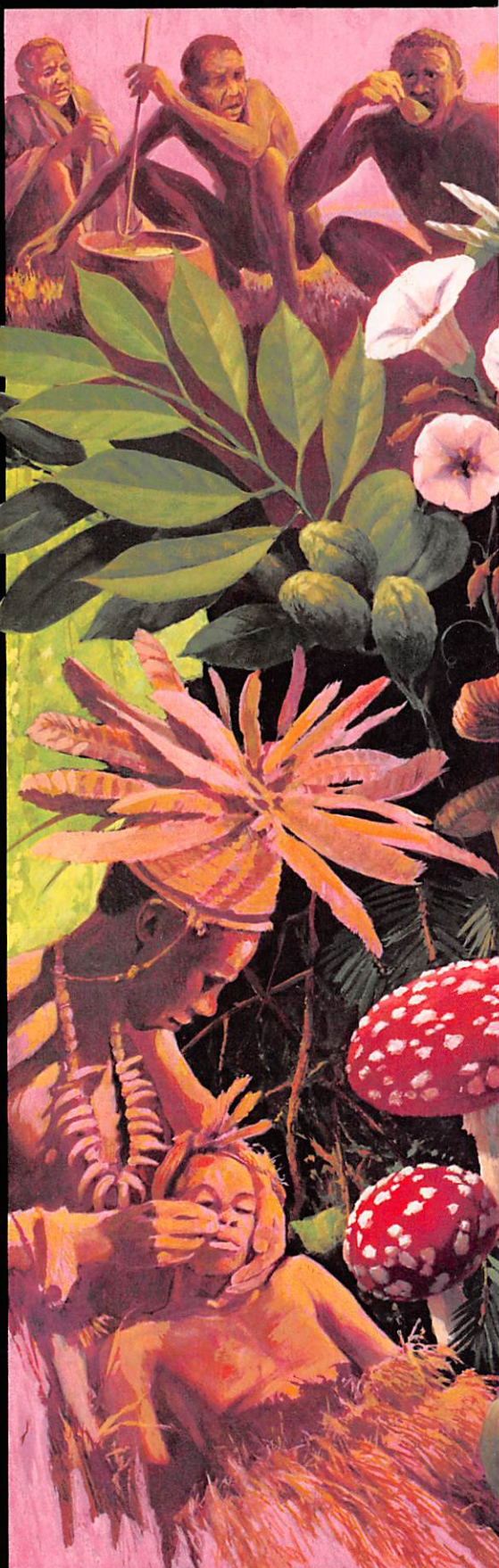
PERILOUS GARDENS BLOOM amid the jungles of primitive societies, where medicine remains entwined with religion and the tools of death grow close at hand.

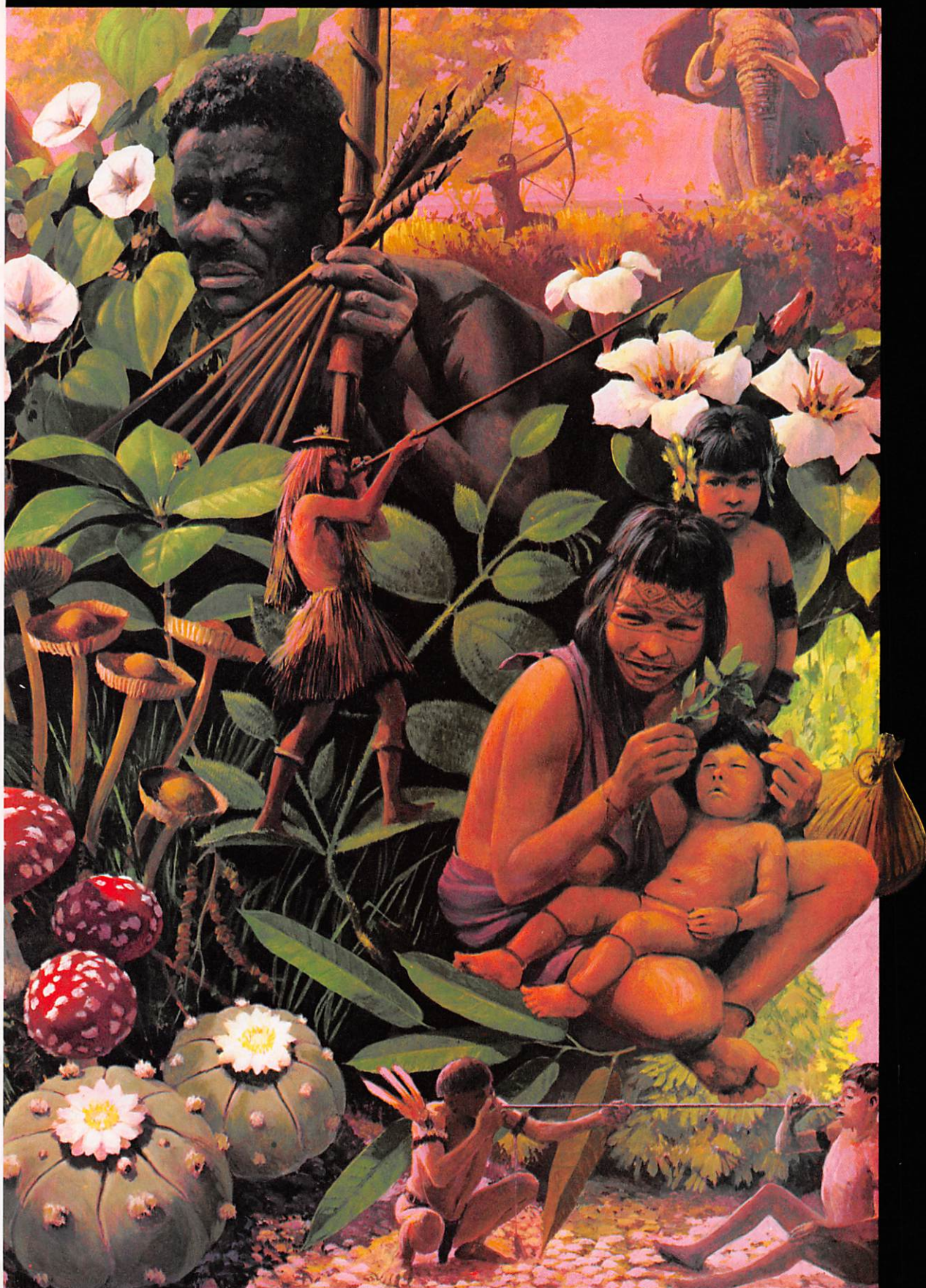
Plucking innocent-seeming plants, tribesmen obtain toxins both for hunting and to try the accused, as at top left. Those who drink and survive are held innocent. Adapted by modern science, these poisons can become beneficial medicines.

African hunters, top right, tip arrows with ouabain, strong enough to stop an elephant; it is also used today as a heart stimulant. South American Indian, at center, fires blow-gun darts tipped with curare, now valued as a muscle relaxant. Less exotic but more widely used, ipecac has been employed as cough remedy and emetic by city dweller and aborigine alike. Cola yields flavoring and caffeine for soft drinks.

Blaming evil spirits for human ills, witch doctors, such as the one at lower left, often give or take hallucinogens in hope of contacting the other world and finding relief for ailments. Aztec worshipers revered the mushroom teonanacatl, as they did the plant ololiuqui, still employed by Mexican Indians to escape the bonds of everyday ills. Waika shaman of Venezuela blows virola snuff into a patient's nostril, lower right, causing nausea followed by a vision-filled stupor. Priests in India 3,000 years ago, it is believed, deified the toadstool fly agaric for its intoxicating juices. The mescaline-rich peyote cactus, still a religious tool of the Navajo and other tribes, sends users into a euphoric state, where reality seems a distant dream. Psychiatric researchers study these mind-benders, seeking help for the mentally ill.

LLOYD K. TOWNSEND





Ancient pharmacy

FAVORITE REMEDIES of an unknown physician are inscribed on the world's oldest medical textbook, a Sumerian clay tablet, top center. It records plant drugs of forty centuries ago.

Though handicapped by superstition and limited technology, early civilizations amassed a wealth of knowledge about medicinal plants. Egypt's Queen Nefertiti, on the bas-relief, offers what appears to be mandrake, a pain-killer, to her ailing husband. Egyptians used the humble onion, center, in the treatment of scurvy among slaves as they toiled to raise the pyramids. The inhabitants of the Nile Valley used aloe to ease intestinal troubles, and henbane as a sedative.

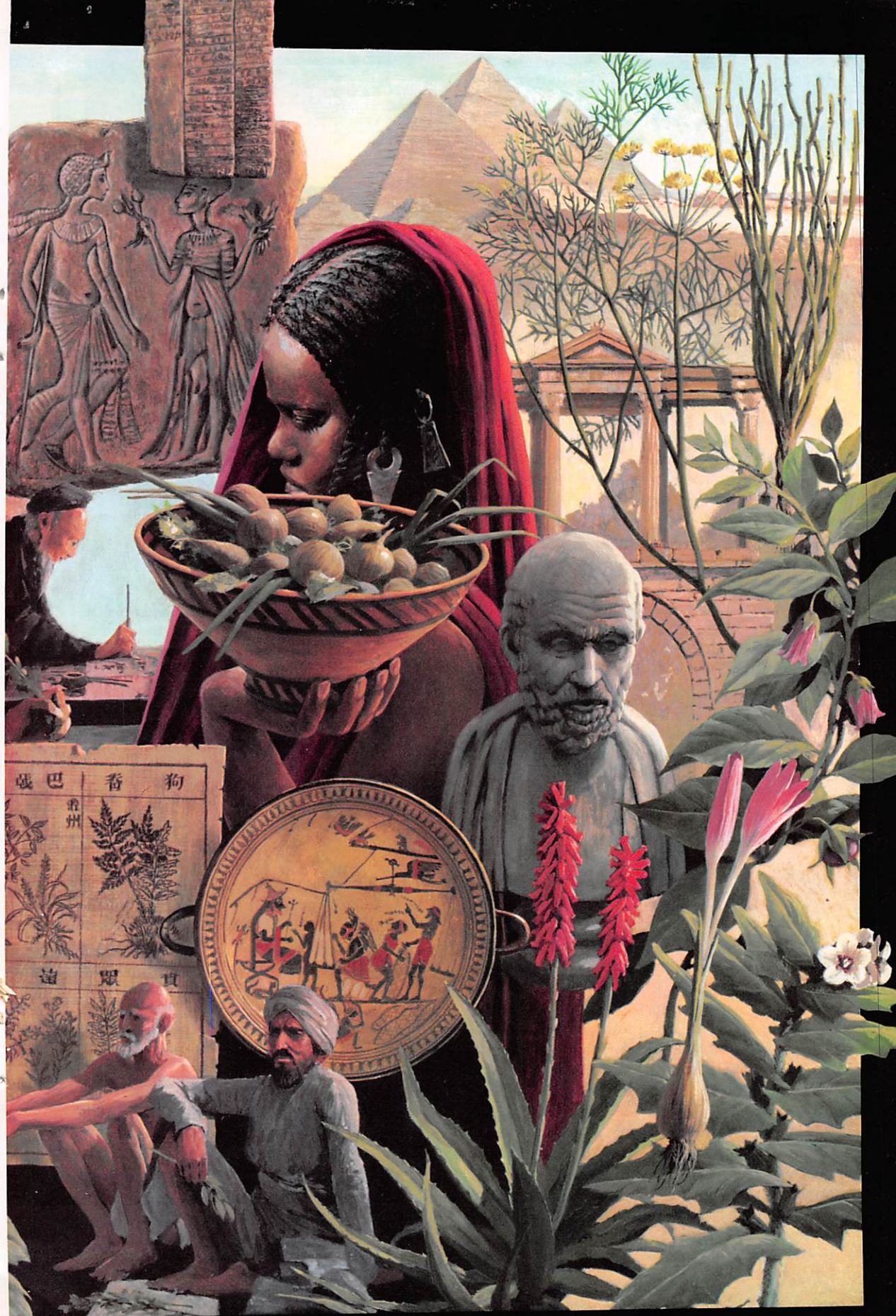
Chinese physicians, left center, cataloged thousands of herbal cures in the delicately illustrated pharmacopoeia *Pên-ts'ao Kang-mu*. Ephedra soothes coughs today as it did 4,000 years ago. Long recognized as a laxative, rhubarb was found growing in China by Marco Polo. Indian doctors calmed disturbed patients with the "medicine of sad men"—*rauwolfia*, the forerunner of modern tranquilizers.

Ancient Greeks and Romans imported North African herbs, which were weighed as the painted dish at center shows. Their plant knowledge included the use of colchicum to treat gout. They gave squill as a heart stimulant, and tansy for worms. Overfed noblemen aided digestion with fennel and senna. Plotters poisoned their enemies with belladonna, deadly nightshade, which later provided the medicine atropine.

The Greek physician Hippocrates, bust at right center, set the stage for the world's turn from charms and chants to practical medicine.

LLOYD K. TOWNSEND





to serve as an astringent or irritation-healing mouthwash.

I saw burlap bags filled with seeds of Italian colchicum, or autumn crocus—the source of a merciful drug used by the early Greeks for the tortures of gout.

We passed a shipment of so-called Peru balsam, actually collected in El Salvador forests. It would yield a viscous liquid to soothe skin ulcers and hemorrhoids.

Here, too, were sassafras roots, wild cherry bark, and goldenseal roots. Gathered by mountain families in what Woodward called "America's wild herb garden of the Blue Ridge," they showed that indigenous Indian herbs still have commercial value in spring tonics, diuretics, and purges.

Many bags contained cathartics. Among these were rhubarb roots and psyllium seeds from India, aloes grown on Caribbean shores, cascara sagrada stripped from Oregon trees, senna leaves from Egypt and elsewhere.

The senna reminded me of a hieroglyphic inscription found at the tomb of an Egyptian court physician who lived more than 4,500 years ago. It listed his official title as "Guardian of the Royal Bowel Movement."

I was particularly intrigued by one bag full of what looked like flat, round buttons.

"With a few of these big seeds you could commit suicide," said Mr. Woodward. "It's nux vomica. It holds strychnine, and is used as a nerve stimulant and in emergencies such as surgical shock and drug poisoning."

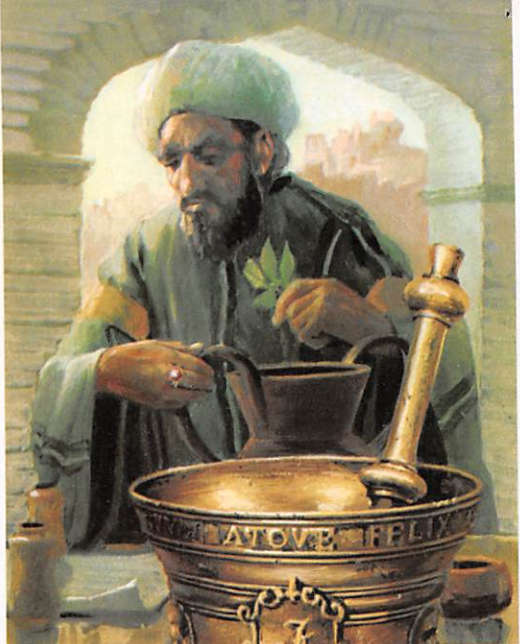
Later I saw giant machines that chop, grind, sift, percolate, and finally spray-dry up to 10,000 pounds of plant extract at a time, or make 3,000 gallons of liquid in a single operation.

The big percolator tanks perform the most sophisticated of the mass-production tasks. Emptying into mazes of glass tubing, they turn crude substances into thousands of drug extracts, using a succession of chemical solvents and ingenious separation equipment.

From then on, the products of once-living things belong to the pharmaceutical chemist, to be purified, modified, and compounded into medicines sold in your corner drugstore.

THE SEARCH for newer and better products goes on, not only in rain forests, deserts, and test tubes, but also in old medical texts, herbals, and world folklore.

In China, home of herbal medicine for thousands of years, the People's Republic is



LLOYD K. TOWNSEND

Concocting mysterious potions, a Moslem pharmacist prepares medicines for a voracious market in the disease-plagued Europe of the Middle Ages. Men paid fantastic prices for remedies produced by Arabs, who controlled the drug and spice trade.

Indispensable to pharmacists, mortar and pestle remain the druggist's symbols. This 16th-century bronze bears in Latin the motto, "May it be lucky and fruitful."

pushing a mass rural campaign to modernize the use of medicinal plants.

Fortified by strong doses of Chairman Mao Tse-tung's revolutionary philosophy, scientifically trained physicians from big-city hospitals cooperate with provincial committees to collect and process herbs prescribed by multiplying legions of "barefoot doctors" of the countryside.

One of the country's most successful herb remedies comes from ground pumpkin seeds. A well-known worm ridder, the seeds have proved effective in treating victims of schistosomiasis, or snail fever, caused by blood parasites carried in waterborne snails.

Closely linked with its herbal program is China's no less ancient practice of acupuncture, the technique of inserting needles into key points of the body. To complement acupuncture, Chinese doctors often give patients

herb drugs to help correct imbalances between the body's yin and yang life-forces, which they believe cause all illness.

At the National Cancer Institute in Bethesda, Maryland, I talked with the author of a series of studies of drug plants that have been used against cancer through the ages. This work provides valuable background for one of the many facets of the multibillion-dollar U.S. research program seeking the causes and cures of the affliction that kills some 350,000 Americans each year.

"The idea came to me in the mid-1940's," said Dr. Jonathan Hartwell, an organic chemist who heads the Natural Products Section of the cancer institute's Drug Development Branch. "I was isolating chemical compounds from the American herb mayapple, when I learned that the Penobscot Indians of Maine had long applied it to cancerous growths.

"Why not compile a list of folklore remedies, I thought, together with other drug plants mentioned in medical and botanical works from ancient times on. These could then be scientifically evaluated for efficacy."

Out of the painstaking labors that followed, Dr. Hartwell has so far assembled data on more than 3,000 plant species. Several have produced extracts that give anticancer promise in tests on laboratory animals and cell cultures. Mayapple itself, or a close botanical relative, is the basis for a drug produced by a Swiss company to treat human brain and lymphoid tumors.

Herb doctors, pharmacologists, and many

amateur plant collectors continue to offer specimens to Dr. Hartwell. The material is passed on for investigation in chemical and biological laboratories holding NCI contracts.

"Most of our work, however," said Dr. Hartwell, "starts with random selection of worldwide plants. We get about 75 percent of such plants from botanists of the U.S. Department of Agriculture. Dr. Robert Perdue, chief of the department's Medicinal Plant Resources Laboratory, has recently returned from a field trip to East Africa."

"MY MAIN HUNTING GROUNDS have been in Kenya and Tanzania," said Dr. Perdue, when I reached him at his Beltsville, Maryland, station, "but I've gathered botanicals on almost every continent.

"My latest trip was the most successful," he said. "With two African assistants and a carryall truck, I got some 1,700 plant samples to be screened for anticancer activity. After fifteen years of experience, I also had my first adventure in the wilds.

"I had stopped for a lunch break beside a stream in the Ruaha National Park, a game preserve deep in Tanzania, when I heard a terrific snort. A huge elephant was approaching in a cloud of dust. I jumped behind a big acacia tree, then peered out cautiously and found myself facing him. This happened several times as the elephant and I shifted positions, before I bolted for the truck. It sounds funny now, but I wasn't laughing then."

Such job hazards are less interesting to



DON CROWLEY

Seeking to preserve fragile mixtures, ancient drug dispensers devised special containers. Greeks of the sixth century B.C. used a gracefully curved earthenware vessel called *lecythos* (far left) to hold medicinal and cosmetic oils. Fifteen hundred years later, the Persians combined artistry with utility in their *albarelo*, whose nonporous glaze vastly improved storage of liquid medicaments. An 18th-century Belgian jar differs only in its decorative form. The blown-glass tincture bottle reigned supreme in American shops until 50 years ago. Today, apothecary jars have disappeared before the onslaught of cheaper and more-versatile plastic containers.

Bob Perdue—or to other government and private plant hunters, with whom I spoke—than are the problems of shepherding their hauls through steps of drying, packing, and transporting them from foreign ports to U. S. quarantine entry. Most exciting of all is getting a favorable verdict on a specimen.

"Of the 70,000 plant products screened under our collection program," Dr. Hartwell told me, "around 1,800 have revealed substances of potential value. One of the latest was found in several species of the East African shrub *Maytenus*, and is being moved vigorously through preclinical tests.

"A few other plants, including purple meadow rue native to the U. S., yield drugs that have reached the stage of human trial. But there are disappointments. *Camptotheca acuminata*, a rare tree from mainland China, gave us a once-promising chemical against solid-tumor malignancies, but after intensive testing we had to drop it as ineffectual."

FOR HODGKIN'S DISEASE and childhood leukemia, the most successful drugs to date grew out of research begun independently in the late 1950's by Dr. Robert L. Noble and his co-workers at Canada's University of Western Ontario, and Dr. Gordon H. Svoboda and his associates at Eli Lilly and Company of Indianapolis.

Both investigations focused on a charming and unlikely rose-and-white ornamental—the Madagascar periwinkle—known to gardeners as "bright eyes." Ironically the researchers were checking widespread folklore that leaves of this tropical plant were good for diabetes. Instead, they discovered an anticancer weapon in alkaloids (organic alkaline substances) extracted from *Catharanthus roseus* (formerly *Vinca rosea*).

Outstanding among many valuable pharmaceuticals eventually developed from the pretty little periwinkle were vinblastine for Hodgkin's disease, which attacks lymph glands, spleen, and liver, and vincristine for leukemia, a disease of the blood.

At Lilly headquarters in Indianapolis, I visited pharmacognosist Svoboda—a slight, intense man, whose discovery and study of 40 "vinca" alkaloids won the American Pharmaceutical Association's 1963 Research Achievement Award in Natural Products.

Dr. Svoboda's accomplishments are the more notable for the minute amount of active material found in the plant. I watched Lilly

workmen grinding and processing great piles of crushed leaves imported from periwinkle farms in India. It takes 12 tons to make one ounce of vincristine sulfate.

How effective are the periwinkle drugs?

"Vinblastine, given alone or with supporting compounds to treat Hodgkin's disease," says Dr. Stephen Carter, associate director of NCI's Cancer Therapy Evaluation Division, "has given 65 to 80 percent remission; that is, two years' or more relief from symptoms.

"Vincristine, when combined with other drugs, has an even higher remission rate—up to 90 percent—for once terminal cases of childhood leukemia."

AT A CONVENTION of psychiatrists in Washington, D. C., Dr. E. Fuller Torrey of the National Institute of Mental Health, gave a provocative talk on nature's gifts to modern medicine in his field.

Although the Western term "witch doctor" implies black magic, he said, such healers of other cultures are no more related to witchcraft than to witch hazel. In fact, they use some of the same drugs and psychology as other therapists. For example, Dr. Torrey cited rauwolfia root as the source of a drug that has been prized as a tranquilizer by centuries of folk healers in India and Africa.

"In 1925," he said, "a famous Nigerian witch doctor was summoned to England to treat an eminent Nigerian who had become psychotic. Armed with his rauwolfia root, the witch doctor certainly had better medicine to offer the psychotic patient than did any English psychiatrist of that period."

How this bitter, twisted root gave the world its first natural drug to calm violently disturbed patients—as well as the still popular remedy for high blood pressure—makes one of pharmacy's best success stories.

The crude drug came from a far-flung shrub of the same dogbane family as the Madagascar periwinkle. Botanists call the genus *Rauwolfia*, for the 16th-century German physician and plant explorer Leonhard Rauwolf.

For at least 2,500 years before Dr. Rauwolf, Indian medicine men had used their "snakeroot" to treat anything from snakebite to cholera. They prized it especially as a cure for "moon madness," or lunacy.

Tribal societies of tropical Africa and Latin America found similar uses for related rauwolfia species. But it was not until the late

1940's, after Indian scientists had isolated active substances from rauwolfia, that Western chemists took to the field.

Beginning with reserpine, developed by the Swiss CIBA company, rauwolfia alkaloids are now made from both natural and laboratory products. Out of India's old moon-madness root has grown a global industry estimated in the United States alone at an annual 80 million dollars.

MORE IMPORTANT, the rauwolfia breakthrough inspired a worldwide field and laboratory hunt for other mind- and mood-altering drugs.

In 1956 the U. S. Congress voted funds to launch a long-range research program under which the National Institute of Mental Health (NIMH) would seek and test such drugs to fight the nation's mental ills. One phase of the program is carried out by the institute's Psychopharmacology Research Branch—a jawbreaking title that means working with medicine for the mind.

In practice, this branch awards grants and contracts for preclinical and clinical studies by qualified outside botanists, chemists, psychopharmacologists, and researchers in mental hospitals.

Another phase of the work goes on within the institute itself in evaluating the safeness and efficacy of psychotropic drugs.

At the National Institutes of Health in Bethesda, Maryland, I visited one of four wards in which the relationship between biochemical abnormalities and depressive,

manic, and schizophrenic illness is studied. Here records are kept of patients' reactions to psychoactive drugs. Sensitive tests measure changing levels of chemicals in the body, and psychiatrists and nurses check shifting behavior patterns.

In the animal laboratory I saw how preliminary techniques check drugs on mice, rats, and monkeys. From the head of one white rat protruded a tiny tube that had been implanted, under anesthesia, to withdraw brain fluids without harming the animal. Another rat bore a crown of electrodes to monitor its brain impulses.

"Only about 5 to 10 percent of our drugs come directly from natural products," said Dr. Frederick K. Goodwin, who heads this psychiatric research unit of NIMH. "But nature is more important than it seems, for chemists often start with a natural product that affects the central nervous system, and go on to develop a new class of synthetics.

"Among our natural drugs are some the public hears more about because of abuse. Cocaine from the South American coca bush is one. Mescaline from peyote cactus, and derivatives of marijuana are others. We prescribe these because of their euphoric or antidepressive qualities," he said, "and use reserpine for the opposite effect of calming the excited manic patient."

A powerful psychiatric tool is LSD (lysergic acid diethylamide). It can temporarily derange a mind when a mere speck is absorbed, leading to serious problems when it is taken for thrills. Its highly publicized use by a few



Lost in thought, an alchemist of the 16th century ponders a formula. Such forerunners of modern chemists spent most of their time trying in vain to change base metals into gold. But some thought their science should focus instead on the preparation of medicines. Though primarily interested in chemicals, Paracelsus, a Swiss, used tincture of opium as a drug. He also revived the "doctrine of signatures," which held that plant remedies could be identified by their resemblance to the afflicted body part. Many plant names like liverwort and heartsease recall that belief.

DON CROWLEY

experimental psychiatrists to induce a "controlled psychosis" is now waning.

LSD, however, is a man-made drug, first synthesized in 1938. It rates mention here as an offshoot of ergot, a common fungus growth on rye and other grains, which yields medically active and useful alkaloids.

The story of ergot is as strange as the fantasies of an LSD user. Though grain bearing the purple mark of an ergotlike blight was feared by such ancient peoples as the Assyrians, midwives of many lands and times have made crude preparations from the fungus to control bleeding after childbirth. Modern doctors still prescribe ergot derivatives for such bleeding, as well as for migraine—a practice that followed the isolation of ergot's active principle at the Swiss laboratories of Sandoz Ltd. in 1918.

Yet the effects of ingesting crude ergot can be appalling. In the Middle Ages mysterious plagues swept the rye-growing regions of Europe. The victims suffered hallucinations, convulsions, and burning sensations called St. Anthony's fire. In severe cases, constricted blood vessels caused dry gangrene, making extremities—hands and feet, even sometimes arms and legs—shriveled and drop off.

Even in recent decades contaminated food has produced outbreaks of ergot poisoning. In 1951 dozens of villagers of Pont St. Esprit in southern France were stricken after eating "the scorching bread." Five died, and survivors are haunted by scenes of sufferers jumping from windows under the delusion they could fly—a recognized symptom of a "bad trip" today with LSD.

DEEP IN THE WORLD'S shrinking wilderness, a new breed of plant hunters is searching for more intoxicating and vision-producing drugs that may furnish clues to the mysteries of mental illness.

The quest has led to aboriginal societies that use such drugs in mystic rites and healing arts. And its pursuit brings together a remarkable range of research scientists, including ethnobotanists, who study primitive peoples in their natural environments; archeologists, who dig up evidence of ancient plant medicines; biochemists, looking for active plant components; and psychiatrists, who prescribe the finished drugs.

In a small specimen-cluttered office of the Botanical Museum at Harvard University, I interviewed a pioneer in the field, Professor

Richard Evans Schultes, director of the museum and a leading ethnobotanist specializing in both psychoactive and general medicinal plants.

A tall, tweedy Bostonian, Dr. Schultes has spent 40 years exploring for and disseminating information on tropical New World plants, from rare orchids and wild rubber to exotic narcotics of Indian tribes.

Before *rauwolfia* made medical headlines, Dr. Schultes studied three drugs sacred to Mexico's pre-Columbian Aztecs: peyotl, from the dried tops of the peyote cactus *Lophophora williamsii*; ololiuqui, brewed from the vine *Rivea corymbosa*; and teonanacatl, the magic mushroom that the Aztecs called "flesh of the gods" and the Spaniards attributed to the Devil. He rediscovered the last two after three centuries of obscurity.

On plant-collecting trips up and down the Amazon Basin, Dr. Schultes has lived and worked for months at a time with some of South America's most primitive tribes.

During one visit, he told me, he was initiated into the Yukuna tribe of eastern Colombia, and when he returned years later, he took along his 10-year-old son to join in the reunion with his friends.

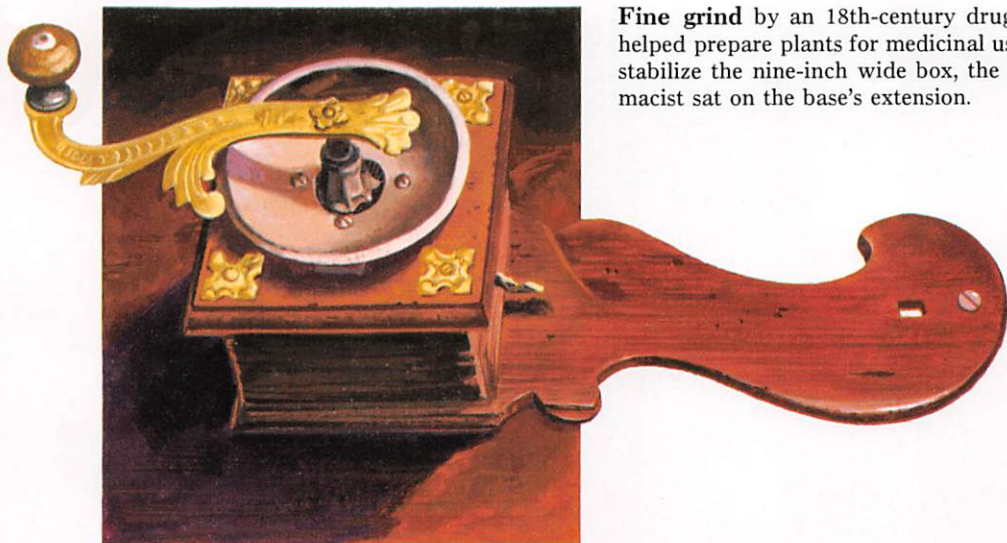
Paddling the tributaries of the upper Amazon and Orinoco Rivers, Schultes suffered malaria, beriberi, and other hardships to gather thousands of specimens for the Harvard botanical collections. But he had the satisfaction of following the trail of his boyhood hero, the 19th-century British botanist Richard Spruce, whom he respects as one of the greatest explorers of South America.

"Nearly a hundred years ago," he said, "Spruce was first to describe several species of the *Viola* genus, an important but then almost unknown group of Amazon trees related to the common nutmeg of the Far East."

Dr. Schultes's own discoveries have carried on the Spruce tradition. In the 1950's he encountered still other *Viola* species, and learned that Indian tribes of Brazil, Colombia, and Venezuela use the trees to make a potent hallucinogenic snuff.

"They scrape a bloodred resin from the inner bark," he said, "then boil and pound it into a powder they snuff to enter the spirit world at sacred ceremonies. In large doses it causes wild intoxication, complete with hallucinations in living color."

Many tribes also make washes and ointments from *Viola* bark, leaves, and seeds,



DON CROWLEY

Fine grind by an 18th-century drug mill helped prepare plants for medicinal use. To stabilize the nine-inch wide box, the pharmacist sat on the base's extension.

Schultes learned, to treat skin diseases, wounds, rheumatism—even bad breath.

"Perhaps some future wonder drug may come from these jungle plants," he said.

One *Viola* product of potential value is the deadly resin that Waika tribesmen smear fresh on arrow tips. The prospect is not as improbable as it sounds, for science already has converted similar poisons.

Curare, the most famous of South American arrow poisons, now serves as a muscle relaxant in surgery and certain forms of paralysis. Ouabain, an arrow and spear poison of tropical Africa, has yielded a powerful stimulant for cardiac cases. And the sinister Calabar beans of West Africa, once brewed into lethal drinks for testing guilt in tribal ordeals, gave ophthalmologists a drug against glaucoma.

ON A SUMMER DAY at the University of Mississippi, I visited an Alice-in-Wonderland garden maintained for the benefit of students in the College of Pharmacy.

I had flown south to consult Professor Maynard W. Quimby, an outstanding economic botanist who had recently joined the expanding pharmacognosy staff of "Ole Miss."

With the delight of a nature lover, Dr. Quimby showed me his research gardens, bright with examples of medicinal plants. I felt as if I were back in college Botany I, sniffing such pungent herbs as tansy, fennel, and peppermint, steeped by centuries of "wise women" to banish sore throat, colic, and other simple ailments.

There were tall castor bushes, from whose seeds castor oil has been pressed since the early Egyptians discovered childhood's hated physic. And twining vines of the velvet bean, a common fodder in which chemists found the active ingredient for the original L-dopa drug, prescribed to relieve symptoms of Parkinson's disease, a nervous-system disorder.

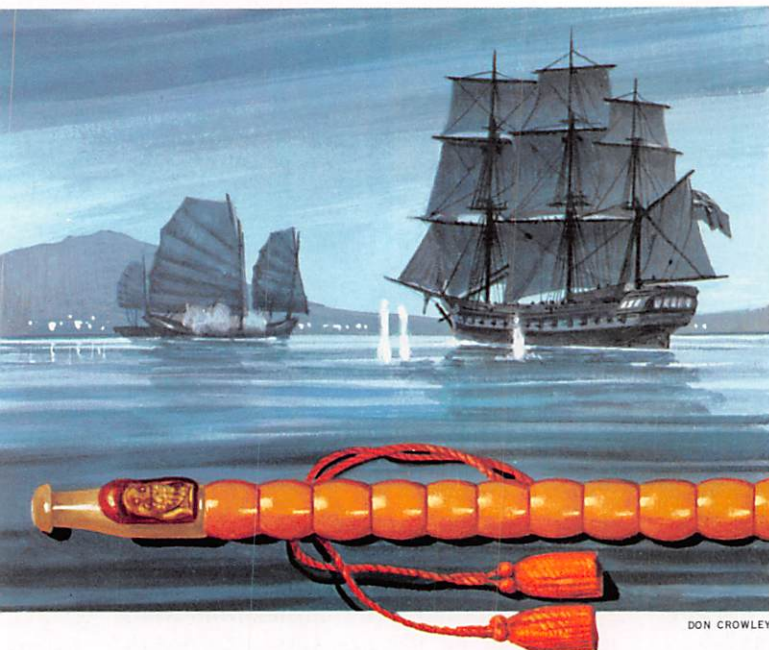
Handsome of all drug plants blooming in that pharmacy of nature was the purple foxglove (*Digitalis purpurea*). It owes its place in medicine to William Withering, the 18th-century physician and botanist of Birmingham, England, who found in its dried leaves the world's leading heart stimulant and regulator—digitalis.

After our tour of the gardens we went to a university storeroom filled with specimens from Dr. Quimby's latest plant-hunting trip into the Nigerian bush of West Africa.

"These fragments represent 30 different species of trees, shrubs, and other plants used in tribal medicine," he said.

"Here's the root of a shrub the Hausa people call *faskori*; they infuse it into a drink for stomach complaints or pound it into a powder applied to open sores. Over there is a woody climber that provides both the Hausa and Twi tribes with fruits they feed to sick children to lower fever, or boil into a decoction to treat jaundice."

But the big surprise of my university visit was to find there a legal marijuana farm, set up by NIMH to supply research projects. Armed men, watchtowers, and barbed wire guard the long rows of this tall, weedy annual,



DON CROWLEY

Closing for action, a British ship meets fire from a Chinese junk in the opium wars of the mid-1800's. The conflict erupted over Britain's smuggling of opium from her Indian colonies to China. No match for the British fleet, China was forced to cede Hong Kong and open her ports to trade. Opium, though remaining illegal, continued to be shipped in, yoking millions to the pipe. Today, the People's Republic has put a stop to the illicit use of opium.

a hemp plant that botanists call *Cannabis* and smokers call pot or grass.

Scores of marijuana strains grow on the university's tract. The mature plants are harvested, dried, and stripped of leaves and other parts, which are then analyzed by complex electronic and chemical devices to reveal the amount of psychoactive compounds each specimen contains. Finally, marked samples are distributed among research groups to test physical and mental effects on volunteer subjects, and thus obtain data on which to base legal controls deemed necessary.

Whatever the prospect for pot smokers, their controversial weed is being seriously studied for its possible medicinal value.

FOR MILLENNIUMS many peoples, especially in the Middle East, have drunk and eaten hashish, the hallucinogenic resin in hemp's flowering tops. But medical use of cannabis is equally old. The earliest Chinese herbal, attributed to the legendary Emperor Shen-Nung of about 2000 B.C., listed the plant as a tonic source. Later herbalists cited other Chinese uses—for female weakness, gout, malaria, and absentmindedness.

Cannabis medication to ease pain and relax taut muscles finally reached England from India in the 1840's, then spread to the Continent and the United States, where physicians prescribed it for such complaints as insomnia, stomach ulcers, migraine, and toothache.

Cannabis went out of style when chemists

in the 20th century developed more effective and standardized drugs. But the recent isolation of the plant's active constituent, THC (tetrahydrocannabinol), has led drug concerns to seek derivatives that would offer physical benefits without the mind-affecting drawbacks of the ancient herb.

"The desire to take medicine is perhaps the greatest feature which distinguishes man from animals," quipped Sir William Osler, noted physician and professor-historian.

Certainly the art of pharmacy has fascinated mankind since the first savage nibbled at an herb to relieve an injury or disease.

In the University of Pennsylvania Museum at Philadelphia, I held in my hand a small clay tablet bearing the world's oldest known prescriptions. Inscribed in cuneiform 4,000 years ago, this tablet came to light when one of the university's archeological expeditions excavated it with other relics of the library buried at Nippur, religious and commercial center of Sumer in ancient Mesopotamia.

Beside me, as I gazed upon that tangible evidence of the practice of some unknown Sumerian physician, stood the erudite cuneiform scholar who had translated the tablet's mysterious hen-scratch symbols.

Dr. Miguel Civil, from the Oriental Institute of the University of Chicago, had joined me on one of his periodic research trips to the museum, and kindly agreed to interpret.

"Here are 15 prescriptions," he said. "They were prepared as poultices, or given by

mouth, or made into washes and salves."

Most of the ingredients came from plants, he explained. The Sumerians squeezed and ground, infused and decocted seeds, leaves, fruits, roots, and bark of such plants and trees as thyme, mustard, fig, pear, myrrh, camel thorn, pine, and willow.

Choosing solvents of water, wine, milk, or beer, they mixed vegetable bits with salt, oil, and river silt; with pulverized turtle shells, bird and bat droppings, powdered snakeskins, and "hair from the stomach of a cow."

IF IT SEEMS STRANGE to put such things in medicine, remember that our ultra-modern drug, the hormone cortisone, was first isolated in the 1930's from the adrenal glands of slaughtered cattle. After animal sources proved inadequate, a worldwide search for plant substitutes turned up a Mexican yam of the *Dioscorea* genus that now provides the starting material for nearly all cortisone.

Any similarity between primitive and present-day doctoring is, of course, purely coincidental. Since ancient societies usually blamed illness on demons that invaded the body, it followed that disgusting and foul-tasting materials, plus prayers and charms, could drive them out.

Gradually, however, as enterprising medicine men experimented with vegetable and animal products, they built up a rude but sometimes effective materia medica. By trial and error they learned which herbs were poisonous, and that even lethal ones might be helpful in minute doses.

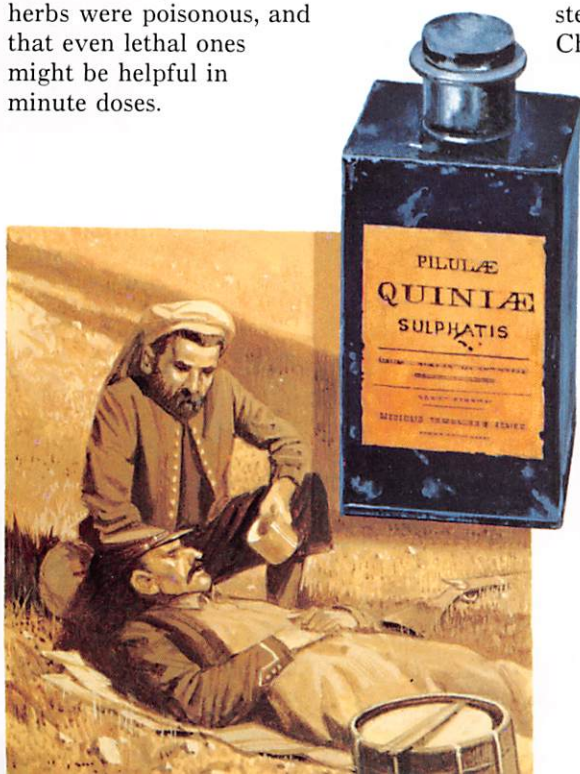
From Babylonian and Assyrian tablets, we know that the heirs of Sumer used deadly nightshade, henbane, mandrake, and thorn apple. We know, too, that these toxic plants have therapeutic value, which scientists now explain by the presence of atropine and scopolamine—still standard drugs to relax eye muscles, relieve spasms, and stimulate the heart.

Egypt's oldest medical records reveal no less inventiveness. In the rambling collection of "recipes" and incantations that make up the hieroglyphic scroll called the Ebers Papyrus, the Egyptians included many drugs that have stood the test of time.

To soothe a crying child, goes one, "take pods of the poppy plant and add fly dirt that is on the wall...strain." Except for the fly dirt, this prescription calls for the same paregoric that pediatricians give colicky babies today in tincture form.

The Nile people also devised a remedy for night blindness from roasted ox liver—a quite reasonable practice in the light of modern knowledge that liver contains vision-aiding vitamin A. The Egyptians even pressed moldy bread to purulent wounds and swallowed it for internal maladies—thus anticipating penicillin and other 20th-century antibiotics from mold cultures and soil bacteria.

One of your doctor's most popular drugs goes back to ancient China. The drug is ephedrine, still prescribed in natural and synthetic form for ailments from asthma and hay fever to low blood pressure and heart block. Its original source was a green-stemmed shrub, *Ephedra sinica*. Native to China as *Ma Huang*, the plant was recommended against respiratory infections long before the learned physician and



Battlefield Samaritan lends a hand to a malaria-stricken comrade during the U. S. Civil War. Quinine—at that time the only effective drug against malaria—saved thousands during the bloody conflict.

Powdered bark of the South American cinchona tree, source of quinine, first reached Europe via Catholic missionaries in the 17th century. Fearful of being "Jesuited to death," Oliver Cromwell and other arch-Protestants refused to be treated. Europe's horror of the deadly "shaking fever" finally overcame the prejudice, and quinine was gradually accepted.

DON CROWLEY

Fraud vs. folk wisdom

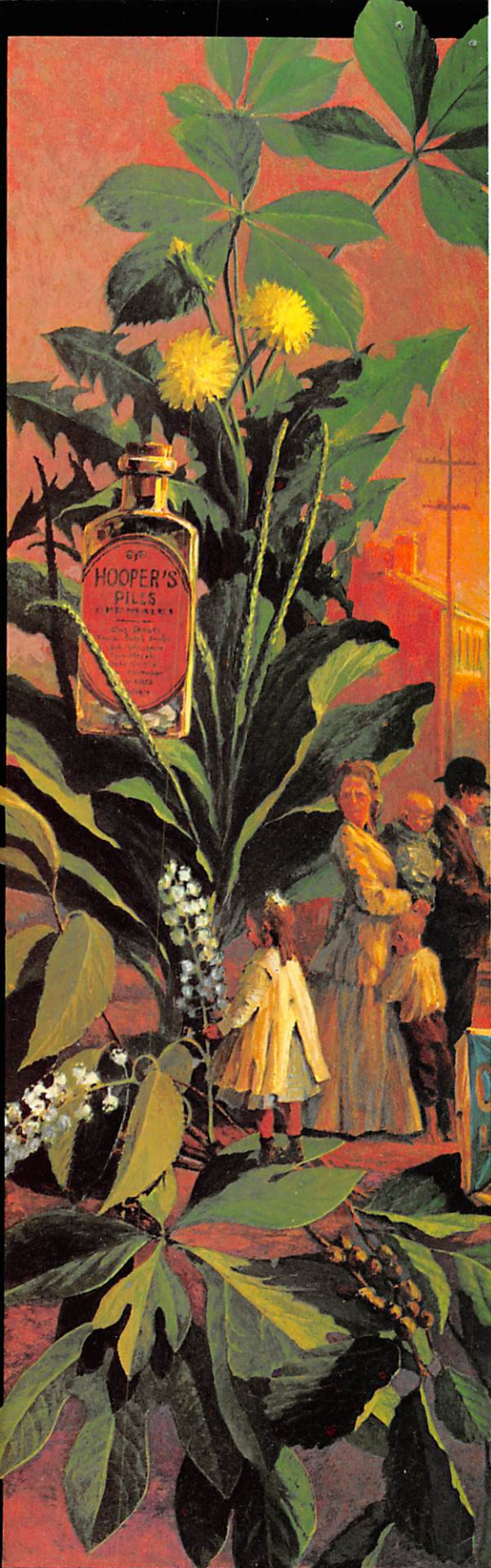
"SURE CURE FOR EVERY COMPLAINT!" Went the patter of traveling quacks who peddled their nostrums to a growing America. Hundreds of patent medicines like Cream of Olives, Hooper's Pills, and Keuchen Cura found widespread acceptance through outlandish claims often coupled with a high alcohol or opium content. One of the best-known remedies, Dr. Morse's Indian Root Pills, promised to cure anything from kidney disease to bad breath.

Showmen's panaceas often included ingredients from the plant world such as sassafras, whose pungent oil has antiseptic properties. But many Americans, unswayed by painted banners and hard-sell tactics, preferred "simples"—homespun preparations of medicinal plants.


Early settlers learned much herbal lore from the Indians, who introduced them to such diverse remedies as mayapple, a cathartic, and golden-seal, whose powdered roots dried the runny noses of overall-clad countryfolk. Wild cherry bark still flavors cough syrups, while witch hazel remains a favorite lotion for insect bites.

Pioneers brewed tonics from dandelion and peppermint to soothe stomachs jounced by covered wagons rumbling west. The people of Appalachia still fashion poultices of plantain for snakebite and jimsonweed for wounds. Ginseng root, an alleged aphrodisiac, remains a favorite ingredient for an all-purpose tonic.

For many years, rural folk treated fevers with a decoction of willow bark. In the 1820's its active principle, salicin, was isolated; in 1899 a synthetic derivative gave the world aspirin.

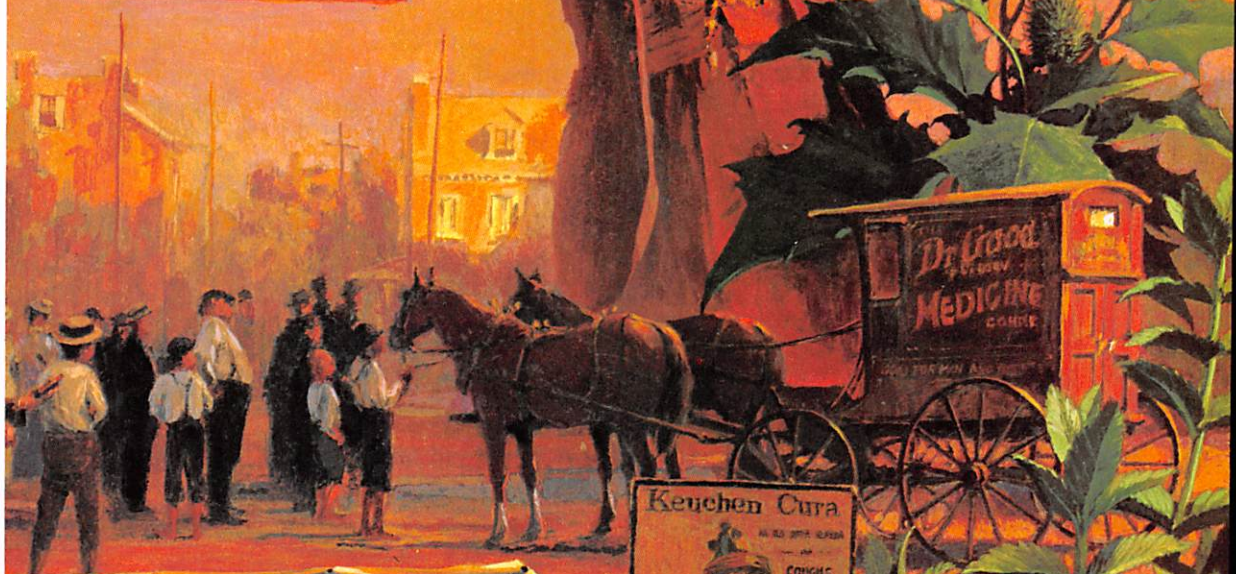


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naturalist Li Shih-chên listed it in his 52-volume *Pên-ts'ao Kang-mu* in 1590.

Yet even as Li Shih-chên completed his life's work, the Western Hemisphere was uncorking a brand-new array of plant drugs. In the wake of the 15th- and 16th-century voyages of discovery, a Spanish physician, Nicolás Monardes, compiled a detailed account of medicinal herbs arriving from overseas to stock the shelves of European dealers.

His book, telling how the Indians used wild roots, barks, and fruits, was "Englished" in 1577 by London merchant John Frampton under the engaging title *Joyfull Newes out of the Newe Founde Worlde*.

Dr. Monardes was fascinated by the coca shrub, whose leaves Peruvian Indians mixed with lime and rolled into balls held in the mouth on long treks over the high, bleak plateaus of South America. "The use of these little Bawles dooe take the hunger and thurst from them," he reported with wonder.

Andean Indians still use coca to escape the harsh reality of their lives. But the "Joyfull Newes" was nearly 300 years old before science isolated the plant's key constituent and called it cocaine. Later (1884) a young Viennese doctor showed that cocaine, used as a local anesthetic, would take the excruciating pain out of cataract and other eye operations.

The discovery touched off one of the first and most far-reaching expeditions of modern medical exploration. In 1885 the pharmaceutical firm of Parke, Davis & Company in Detroit—already active in seeking plant materials as far away as the Fiji Islands—dispatched Dr. Henry Hurd Rusby to South America to collect coca and other drug plants. After months of horrendous hardships and adventures in the jungles of the Amazon headwaters, Rusby brought back not only coca supplies but also some 45,000 other botanicals for medical research. Many provided new sources of worthwhile drugs.

THE SAME ANDEAN SLOPES on which Spanish pioneers found coca growing also produced the world's first real cure for the curse of malaria, which has killed more people than any other disease in history. The secret lay in the bark of a flowering evergreen that Linnaeus would mistakenly name *Cinchona* for Countess de Chinchon, wife of a 17th-century viceroy of Peru.

The great Swedish botanist erred in believing that the countess introduced the

powdered bark after it cured her own chills and fever. But the drug's power was no myth. Exported to Europe about 1645, it eased the torments of malaria for thousands.

How the Peruvian bark worked its wonders was learned in 1820, when pharmaceutical chemists extracted one of the alkaloids and dubbed it quinine, for the old Indian term *quina-quina*, "bark of barks." Seventy-seven years later Sir Ronald Ross, a British bacteriologist in the Indian health service, proved that malaria was caused by a microscopic organism transmitted by the *Anopheles* mosquito. The two epochal discoveries led to the draining of vast mosquito-breeding areas, to insecticide spraying, and the marshaling of an arsenal of synthetic antimalarials. But the war is far from won.

"Resistant strains of the parasite, like those that infected American troops in Southeast Asia, have driven us back to quinine," said Col. Ray Olsson, director of the Division of Medicine of the Walter Reed Army Institute of Research in Washington. "Since the appearance of the virulent Viet Nam type of falciparum malaria in the 1960's, the best treatment has been quinine combined with supporting synthetics."

THE CHEMICAL REVOLUTION that made such progress possible began in 1806, when a German apothecary apprentice named Friedrich Sertürner isolated the first active alkaloid of a natural drug.

The drug was raw opium from the poppy *Papaver somniferum*. Its essence was a narcotic component that Sertürner called morphine after Morpheus, the god of dreams, and doctors know as a great pain-killer.

But medical science will be forever indebted to Sertürner not just for controlling pain, but also for pointing the way to the later separation of other alkaloids such as cocaine and quinine that could be prescribed for specific ills. Gradually biochemists developed more effective natural drugs, and eventually, by chemically modifying molecules, created synthetics mother nature never knew.

Consider the willow tree. For thousands of years, willow bark and leaves yielded resins and juices to ease the aches and pains of rheumatism, neuralgia, and the like.

The active ingredient in such remedies was revealed in the 1820's and called salicin, for the willow genus *Salix*. Chemists, however, continued to seek improved derivatives and

finally came up in 1899 with a related synthetic product they named acetylsalicylic acid. Another name is aspirin.

YET ALL DRUGS, even the synthetics, go back to nature. And so did I. When the spring rains and hot summer sun greened the Appalachian highlands, I went up into the hills where the borders of North Carolina, Virginia, and Tennessee meet.

I chose this section because it lies in the heart of the region that provides most of America's wild plants for the drug trade.

"Appalachian dealers buy and sell more than 125 species of medicinal plants," economic botanist Arnold Krochmal, of the U. S. Forest Service, told me when I visited his office in Raleigh. Dr. Krochmal himself has the rewarding job of expanding use of forest resources while helping mountain people augment their meager incomes by harvesting nature's bounty.

From Boone, North Carolina, I rode one of the collecting trucks of a leading dealer—the Wilcox Drug Company, founded in 1865 by the great-grandfather of the present owners, Kenneth and Gary Wilcox.

"On a good day we make up to fifty pickups of herbs, roots, barks, and berries," said the Wilcox driver, Ralph Proffit, as we bounced along a twisting road past small weatherworn mountain homes. "On a real

fine haul, we've carried almost nine tons."

At nearly every house, it seemed, men, women, children, dogs, and cats came out to meet the honking truck. Jumping down with Mr. Proffit, I admired his efficiency as he swapped greetings with his clients, weighed their big burlap bags of dried vegetation on his portable scales, tossed the stuff in his truck, wrote a check, and drove on.

But the cash-and-carry bundles were disappointingly light on that trip, chiefly because of rain that had left drying sheds piled with plant materials too wet to sell.

"Been feelin' kinda puny, too," said a woman who had filled only two company bags with witch hazel leaves and sassafras bark.

On the other hand, a small ridgetop store yielded a neighborhood collection of 17 bags, many weighing more than 100 pounds. Mr. Proffit told me that his annual account with one country store in Virginia comes to \$50,000.

Back at the Wilcox warehouse in Boone early next morning, I studied the company's price list. Most of the desired items—angelica root to wahoo bark—brought from less than a dollar to as much as \$5 a pound. Topping everybody's list, however, as I learned on visits with other dealers in Coeburn, Virginia, and Bristol, Tennessee, is ginseng, or "sang," as mountain folk call it.

Wild ginseng roots, sometimes forked in the shape of a man's body, have been prized from

Prescriptions and sundaes: mainstays of the drugstore of the 1930's. A familiar landmark across the nation, this singularly American institution came into its own as 19th-century patent medicine succumbed to 20th-century science.

With the advent of radio, over-the-counter drugs found a growing marketplace. Manufacturers seized the opportunity to spread their sometimes ambiguous messages to millions of listeners. Today, mass advertising comes under the government's watchful eye.



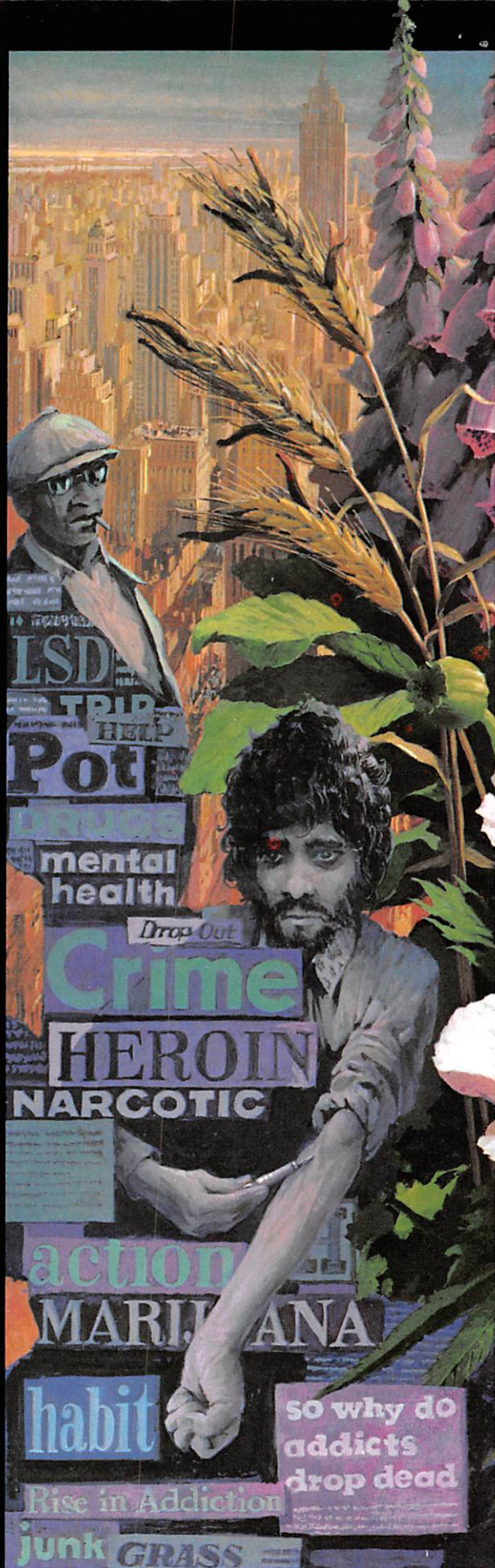
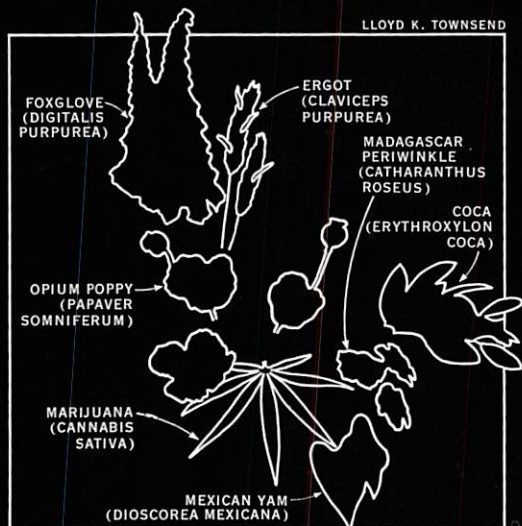
Drugs—helpful and hazardous

MIXED HEADLINES reflect two faces of nature's bounty. Helping to save lives in hospitals, plant-derived drugs become a scourge on city streets. Its tentacles snaking toward America from Asia and the Middle East, heroin gains new strangleholds on youthful victims. Yet morphine, a first cousin, remains an unexcelled vanquisher of pain. Both drugs stem from the same source: the seed pod of the opium poppy.

Indians of the Andes chew leaves of the coca bush as a hunger-reducing stimulant. This divine plant of the Incas yields cocaine—a valuable tool in local anesthesia, but a danger to growing ranks of abusers. Controversy surrounds the use of marijuana, prescribed for pain until 40 years ago. Though its long-term effects remain undocumented, millions of Americans have experimented with the weed. Extracts from ergot, a rye-attacking fungus, can relieve migraine and control hemorrhaging at childbirth; the mold is closely related to mind-blowing LSD.

Not all plant remedies have such ominous overtones. A wild yam holds starting material for cortisone, used to ease crippling arthritis. "Power over the motion of the heart" wrote an 18th-century British physician of foxglove-derived digitalis—today a major weapon in combating congestive heart failure.

From the Madagascar periwinkle come anti-cancer agents. Chemists process 12 tons of the herb to obtain one ounce of a drug that may prolong the life of a leukemia-stricken child.





What does the future hold?

Computers may help answer unresolved medical questions. Now, for example, the electronic brains tell doctors what to expect if they combine one drug with another. Though technological advances allow chemists to create synthetic drugs, research continues on plants as scientists hope to uncover still more cures for man's ills.



DON CROWLEY

remote times as a stimulant, aphrodisiac, and cure-all for ailments, including hangover.

Long one of the most expensive ingredients of Chinese medicine, these roots now command ever-higher prices. Last year Appalachian dealers in American ginseng (*Panax quinquefolium*) were paying local diggers nearly \$70 a pound for good-quality material.

Yet the significance of the root lies not in its cost or persistent folklore mystique, but in the possibility that it may actually contain chemical substances of therapeutic value. Though Western physicians still regard ginseng's benefits as largely psychological, scientific tests in the Soviet Union and elsewhere indicate that infusions of the root may, indeed, increase energy and resistance to infection.

According to a recent article in Chicago's Field Museum Bulletin, "...research with ginseng is being actively pursued in science labs the world over; its effect on tumors, corneal opacity and bacilli... are just a few

of the areas of research being explored..."

As I talked with mountain herb collectors and world-famous pharmacognosists, I kept thinking of lines found among the field notes of a plant hunter and quoted in Margaret Kreig's book, *Green Medicine*:

"I wonder what's around the bend?
said the explorer.

I wonder what that plant is?
said the collector.

I wonder what's in it?
said the chemist.

I wonder what activity it has?
said the pharmacologist.

I wonder if it will work in this case?
said the physician.

I hope she lives!
said the father.

Please, God!
said the mother.

I think she'll be all right in the morning,
said the nurse." □

SIX-MONTH INDEX AVAILABLE

As one of the benefits of membership in the National Geographic Society, an index for each six-month volume will be sent free, upon request, to members who bind their *GEOGRAPHICS* as works of reference. The index to Volume 145 (January-June 1974) is now ready.